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Case Study

Anatomical Relationships for Orienting Dental Casts on an Articulator on the Transverse Horizontal Hinge Axis. Hinge Axis Located for Use

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Abstract

This article presents a technique for locating the transverse horizontal axis, hinge axis, and mounting dental casts on any articulator on this axis. The transverse horizontal axis is the starting and end point in dentistry. Anatomical relationships have been identified that, when used clinically, can predictably achieve this result. This information has been implemented in private clinical practice in multiple locations and by multiple clinicians for the past 25 years for the fabrication of fixed, removable, and combination cases of both natural and implant-supported dentition. The results of this technique are enhanced accuracy and minimal post insertion adjustments. Using this anatomical relationship allows for an easy, accurate, predictable and cost-effective way to orient dental casts on any articulator system on the transverse horizontal axis.

Keywords: *Anatomical Relationships; Dental Casts; Articulator; Horizontal Hinge Axis*

Dental casts on an articulator should ideally be oriented with the transverse horizontal axis. This article describes a technique for consistently mounting dental casts on the transverse horizontal axis. A thorough literature review has shown that no articles have discussed the transverse horizontal axis with regards to dental cast orientation using the anatomical landmarks and relations presented in this article.

The ability to place dental casts on any instrument on the transverse horizontal axis is the basis for the success in the dental clinical setting. If the casts are mounted in a position that is not coincident with the transverse horizontal axis, errors that require corrections will result.

Various fixed anatomical landmarks are repeatable, symmetrical and slow to change if they change at all. Accordingly, clinicians can rely on these fixed anatomical landmarks, which can be easily located and utilized to verify other relationships, such as tooth position, ridge position, the smile line, the planes of occlusion, and the amount of tooth revealed by a high smile. This starting point equips a clinician with the ability to gain an anatomically accurate perspective. An accurate perspective allows for an accurate understanding of inter- and intra-arch relationships and occlusal relationships, which is an understanding that leads to accurate diagnosis and treatment planning. This perspective also facilitates an accurate fabrication of restorative prosthesis and surgical guides. Once the casts are mounted in a proper relationship to each condylar element of whichever articulator is used, the clinician can work on the transverse horizontal axis.

Needles said that "physics exists in the mouth" [1]. Landmark anatomy has been identified and is well documented in the literature [2,3]. This critical anatomy, like retromolar pads, needs to be captured in dental impressions and not trimmed off the cast. There is a learning curve, as with any technique, to identify the pads, verify they are captured in the impression, and maintain them on the models.

Case Study and Discussion

Retromolar pads are generally accepted as a fixed landmark entity that is reliable enough to set the plane of occlusion by it. Spee noted the relationship between the occlusal tables of the teeth and the retromolar pads [2,3]. When setting denture teeth, the pads are used to establish the plane of occlusion during the fabrication of a complete removable denture or distal extension removable partial denture. This information is also necessary for the fabrication of a fixed prosthesis. Without the proper anatomical landmarks, orientation to the plane can be lost.

Variable anatomical landmarks are "landmarks that can be utilized for some information but can change" [4]. Such anatomical entities are the tuberosity, incisive papilla, contours of the ridge, and position of the ridge. These entities are important but not utilized for orientation purposes.

Lopez noted "defined symmetric occurrence is the recognition that there is a resemblance and relationship to position, of paired anatomical body parts" [4]. Using symmetric occurrences facilitates a more accurate perspective of oral relationships and orientations. For example, the left eye is about the same level as the right eye, and the left ear is about the same level as the right ear. Similarly, the left condyle is at about the same level as the right condyle, and the left retromolar pad is located at about the same level as the right retromolar pad.

Of course, slight anatomical variability always exists. The discussion of cases where symmetry does not exist because of a syndrome or trauma is beyond the scope of this article. As seen in figure 1, the contralateral condyle should be located where Line B is drawn. Similarly, the right retromolar pad should be located along the same imaginary line as the left retromolar pad, which can be visualized intraorally and on the dental cast.

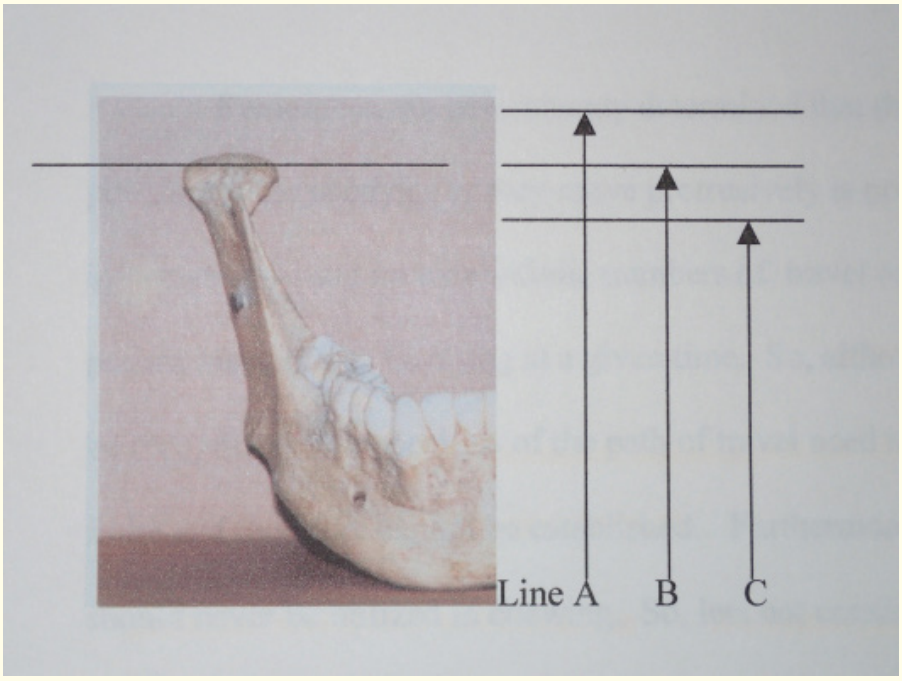

Figure 1: *Half the mandible is shown to illustrate symmetric occurrence.*

The retromolar pads are generally utilized as reference points in the construction of a removable dental prostheses. In figure 2 and 3 Line A results from the connection of two points: the right and the left condyles. Line B results from the connection of two points: the right and the left retromolar pads. The condyle is found where rotation on the transverse horizontal axis takes place. When a vertical transversal line is drawn between lines A and B, equidistant line (See figures 3 and 4), if any pair of corresponding angles, alternate interior angles, alternate exterior angles, or consecutive interior angles are equal to or add up to 180 degrees, the lines are parallel. The relationship between the two horizontal lines is a geometric principle not philosophy [5]. This principle illustrates the additional significance of the retromolar pads, which are fixed landmarks that can be visualized intraorally. With the understanding of this relationship, the transverse horizontal axis can be seen intraorally by visualizing the horizontal line connecting the retromolar pads and by knowing its relationship to the horizontal line connecting the condyles.

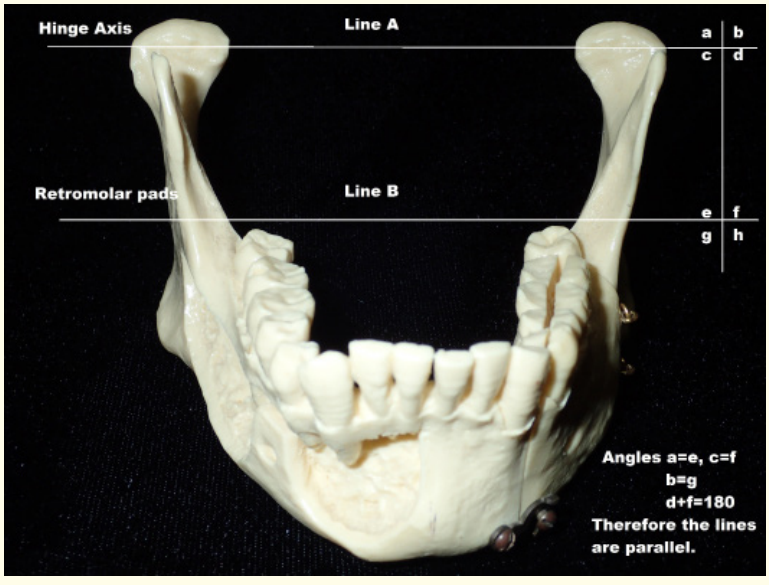

Figure 2: *The mandible, showing the relationship of the hinge axis to the retromolar pads.*

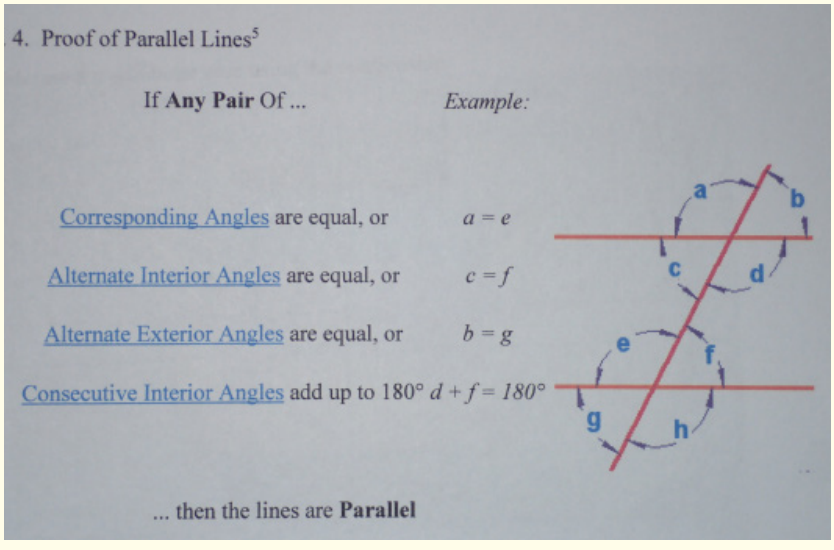

Figure 3: *Proof of parallel lines.*

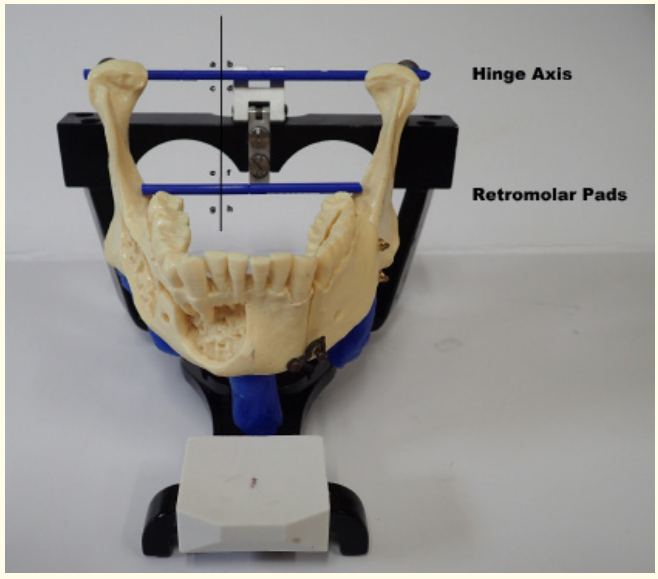

Figure 4: *The retromolar pads' relationship to the hinge axis applied to an articulator.*

The Curve of Spee relates the retromolar pads to the anatomical relationship with the occlusal table, resulting in the plane of occlusion [2,3]. The retromolar pads are the reference point for the Curve of Spee [2,3]. There is an anatomic symmetric occurrence4 between the condyles, the retromolar pads, the Curve of Spee and the plane of occlusion. Due to these relationships, the retromolar pads are a reference point for the transverse horizontal axis. Therefore, the retromolar pads are related to the transverse horizontal axis in a symmetric occurrence and can be used to mount dental casts that possess retromolar pads on an articulator (See figures 5-9). Capturing the retromolar pads in the impression and maintaining these pads when trimming the cast is imperative. Some pads are short and squat, some are long and narrow, and others are a variation thereof. The pads are present regardless of whether the arch possesses no teeth; natural dentition, or implant-supported teeth. Accordingly, the pads fulfill the definition of a landmark.

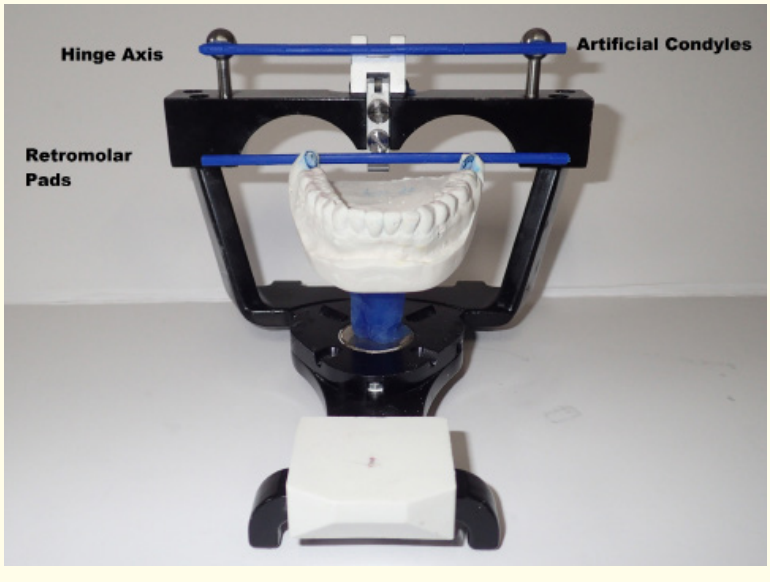

Figure 5: *Dental cast orientation to artificial condyles using retromolar pads.*

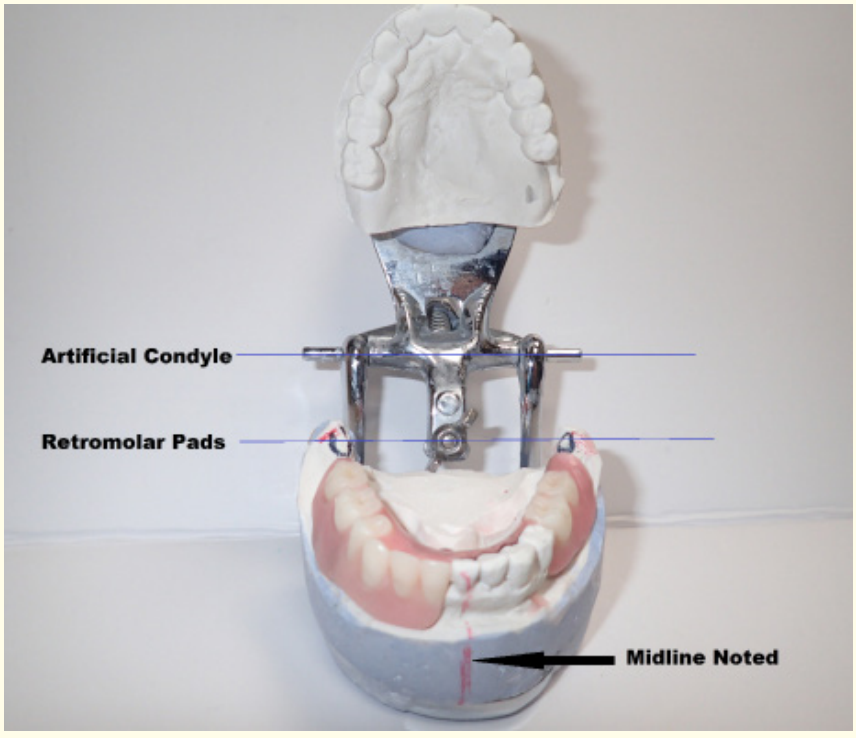

Figure 6: *Dental cast orientation on a simple hinge articulator.*

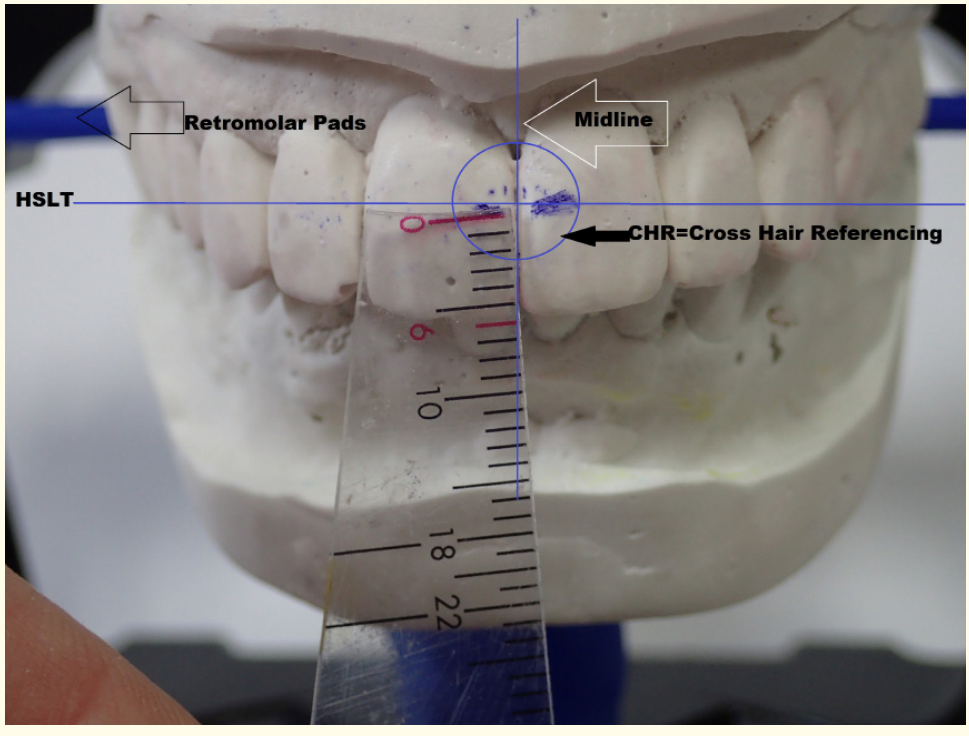

Figure 7: *High smile and midline; crosshair referencing.*

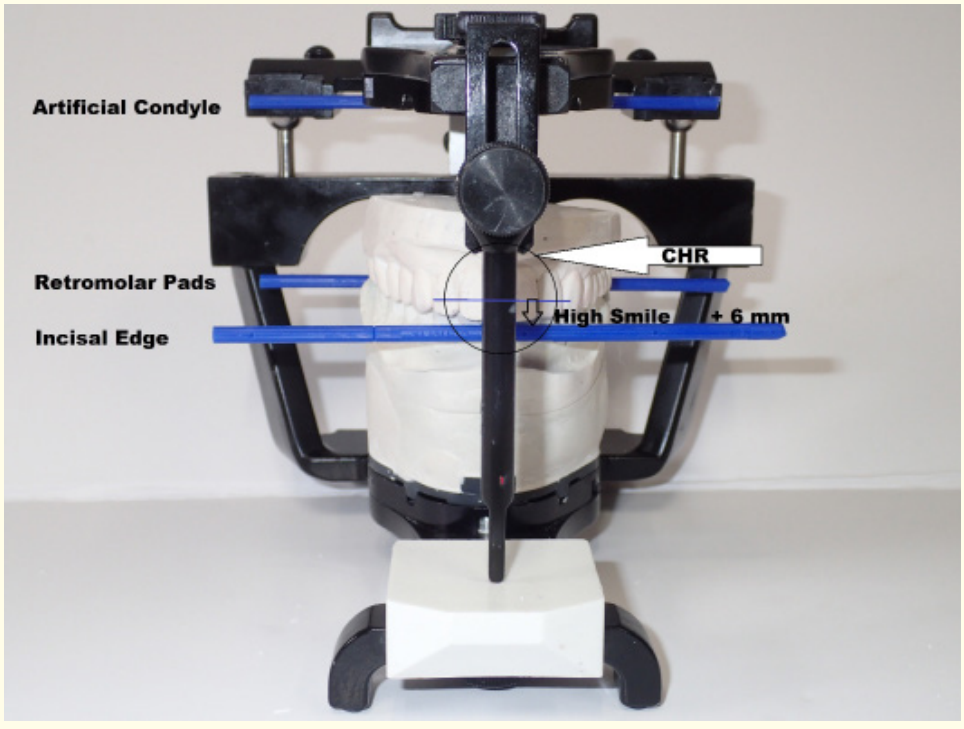

Figure 8: *Using the retromolar pads, midline, and high smile line theory to orient dental casts on an articulator.*

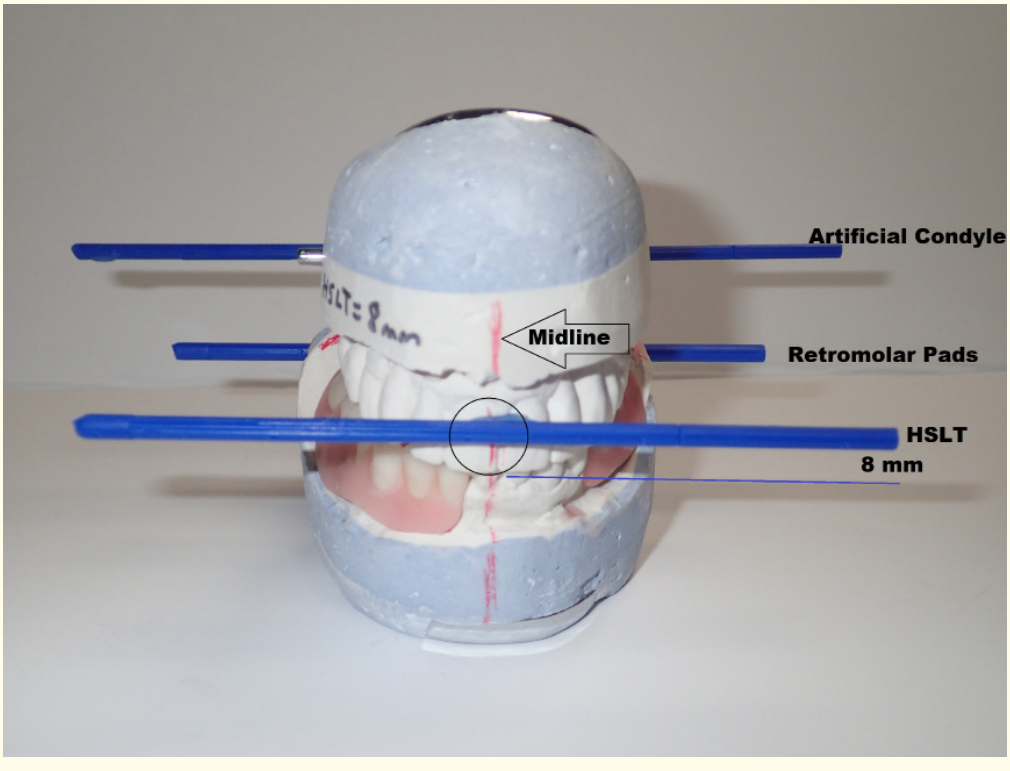

Figure 9: *Orientation of dental casts on a hinge articulator.*

Typically, the clinician and laboratory fail to utilize these reference points when fabricating a fixed dental prosthesis (see figures 11-13). The rationale for using the retromolar pads when fabricating a crown, a prosthetic bridge, or a fixed implant-supported prosthesis is the same rationale as the rationale for the protocol for a removable prosthesis. The retromolar pads are as important a reference point for a fixed restoration as for a removable one. IRT, instrument rate tray like a custom tray, is an impression tray that captures landmark anatomy (Figure 10).

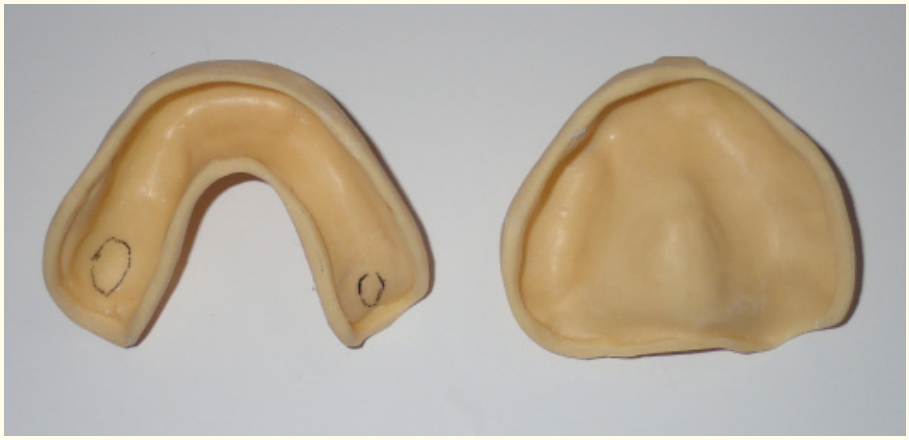

Figure 10: *IRT Instrument Rated Trays, mandibular and maxillary.*

Figure 11: *Final impression of fixed case with retromolar pads captured.*

Figure 12: *Master casts for fixed case showing retromolar pads preservation.*

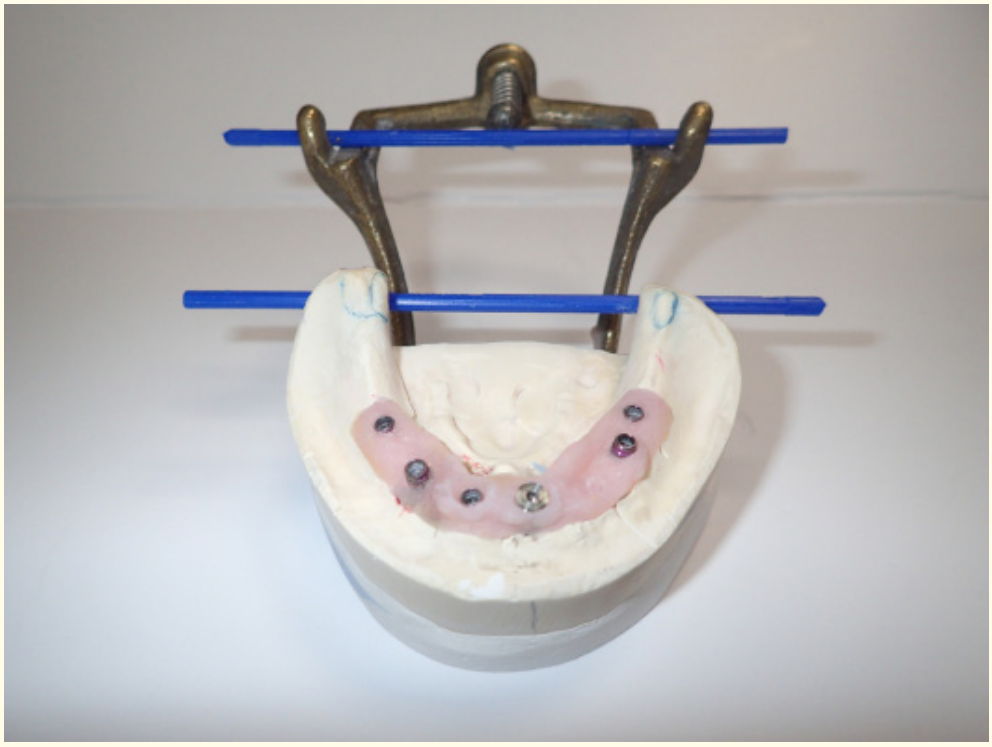

Figure 13: *A hinge articulator with implant case oriented to artificial condyles.*

A fixed restoration that is above or below the plane of occlusion is as incorrect as a removable prosthesis and will be subjected increased or decreased forces accordingly. This issue is based on the engineering principals of leverage and is beyond the scope of this article.

At this point, the key relationships that are critical to understanding the transverse horizontal hinge axis and its relationship to landmark anatomy that can be utilized clinically have been identified. However, so far, only two reference points have been identified: the right and left retromolar pads. A third point is needed in the anterior to assist with orientation of the dental cast on the articulator.

High smile line theory (HSLT) [4], which was defined in 1990, provides a measurement for the anterior point. (see figure 7-9). This measurement is made by asking the patient to smile as widely as they can and measuring the distance from the inferior border of the maxillary lip to the incisal edge. This measurement will be, on average, between 6 and 9 mm. If the patient is edentulous, the high smile measurement will be noted on the wax rim. Using this method, the clinician scribes a mark on the wax rim where the inferior border of the maxillary lip is located during the high smile near the midline. The smile is created by activated musculature [4]. The musculature of the high smile line will always go to its natural position. Notably, there is a difference between this point and a smile line, which is a difference that is typically of interest when evaluating facial aesthetics. HSLT is a point and the smile line is an evaluation of the entire lip. HSLT is used to orient and mount the dental cast parallel to horizontal axis on the articulator. The retromolar pads orient the dental cast on the transverse horizontal axis.

Noting the high smile line and the midline creates perpendicular lines. This technique is referred to as crosshair referencing (CHR). CHR provides the proper perspective of the orientation of the mandibular dental cast to the articulator (see figures 7-9).

During the mounting procedure, the mandibular cast is oriented with the retromolar pads parallel to the artificial condyles on the articulator. The cast is supported by wax, and the maxillary cast is placed using CHR. The casts can then be centered using the midline on the maxillary cast, and the high smile point which is typically found around the level or 1 mm below the level of the retromolar pad line. The retromolar pads must be parallel to the artificial condyle so that the clinician can orient the dental casts on the transverse horizontal axis. It does not matter how far from the hinge the casts are mounted on the articulator much like how a door must be oriented properly on its hinges but the doorknob can be placed anywhere. The arc of closure is irrelevant when placed on a hinge axis. The distance of the casts from the artificial condyles is irrelevant if the orientation is parallel because this orientation puts the dental casts on the transverse horizontal axis. The distance between the dental cast position on the articulator regarding right and left is also irrelevant. However, we prefer to center the casts [6-14].

Conclusion

When the fabrication of a dental prosthesis is done on dental casts mounted in the correct orientation on hinge axis the clinical result is a significant reduction in the amount of modifications that are needed to insert that prosthesis intraorally. This article has identified the anatomical relationships of the hinge axis. These relationships are critical to the orientation of the mandibular cast on an articulator. The maxillary cast is mounted after the mandibular cast. Three points are referenced for the orientation of the casts and the identification of the plane of occlusion. The retromolar pads are a critical fixed landmark relative to the transverse horizontal axis and are used as the posterior determinants. The HSLT is used for the anterior determinant and is measured from the inferior border of the maxillary lip during a high smile plus 6 - 9 mm. Once the casts are oriented to the hinge axis, the clinician can accurately evaluate, calculate, and understand what modifications will be needed to fabricate a prosthesis. When the prosthesis will be inserted into the stomatognathic system it will exist within anatomically correct parameters.

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Conflicts of Interest

None.

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